

January 8, 1852.

COLONEL SABINE, R.A., V.P. and Treas., in the Chair.

Charles Wheatstone Esq., F.R.S., delivered the Bakerian Lecture, being the substance of his paper entitled, "Contributions to the Physiology of Vision.—Part II. On some remarkable, and hitherto unobserved, phenomena of Binocular Vision,—(continued)." Received January 8.

The first part of these researches was communicated to the Royal Society in 1838, and published in the Philosophical Transactions for that year.

The second part, now presented, commences with an account of some remarkable illusions which occur when the usual relations which subsist between the magnitude of the pictures on the retinae and the degree of inclination of the optic axes are disturbed. Under the ordinary circumstances of vision, when an object changes its distance from the observer, the magnitude of the pictures on the retinae increases at the same time that the inclination of the optic axes becomes greater, and *vice versa*, and the perceived magnitude of the object remains the same. The author wished to ascertain what would take place by causing the optic axes to assume every degree of convergence while the magnitude of the pictures on the retinae remained the same; and, on the other hand, the phenomena which would be exhibited by maintaining the inclination of the optic axes constant while the magnitude of the pictures on the retinae continually changed. To effect these purposes, he constructed a modification of his reflecting stereoscope; in this instrument two similar pictures are placed, on moveable arms, each opposite its respective mirror; these arms move round a common centre in such manner, that, however they are placed, the reflected images of each picture in the mirrors remains constantly at the same distance from the eye by which it is viewed; the pictures are also capable of sliding along these arms, so that they may be simultaneously brought nearer to, or removed further from, the mirrors. When the pictures remain at the same distance and the arms are removed round their centre, the reflected images, while their distances from the eyes remain unchanged, are displaced, so that a different inclination of the optic axes is required to cause them to coincide. When the arms remain in the same positions and the pictures are brought simultaneously nearer the mirrors, the reflected images are not displaced, and they always coincide with the same convergence of the optic axes; but the magnitude of the pictures on the retinae becomes greater as the pictures approach. The experimental results afforded by this apparatus, so far as regards the perception of magnitude, are the following: the pictures being placed at such distances, and the arms moved to such positions, that the binocular image appears of its natural magnitude and its proper distance, on the arms being moved so as to occasion the optic axes to converge less, the image appears larger, and on their being moved so as to cause the optic axes to converge more,

the image appears less; thus, while the magnitude of the pictures on the retinae remains constantly the same, the perceived magnitude of the object varies, through a very considerable range, with every degree of the convergence of the optic axes. The pictures and arms being again placed so that the magnitude and distance of the object appear the same as usual, and the arms being fixed so that the convergence of the optic axes does not change; while the pictures are brought nearer the mirrors the perceived magnitude of the object increases, and it decreases when they are removed further off; thus, while the inclination of the optic axes remains constant, the perceived magnitude of the object varies with every change in the magnitude of the pictures on the retinae. After this the author takes into consideration the disturbances produced in our perception of distance under the same circumstances, and concludes that the facts thus experimentally ascertained regarding the perceptions of magnitude and distance, render necessary some modification in the prevalent theory regarding them.

The author next reverts to the stereoscope and its effects. He recommends the original reflecting stereoscope as the most efficient instrument, not only for investigating the phenomena of binocular vision, but also for exhibiting the greatest variety of stereoscopic effects, as it admits of every required adjustment, and pictures of any size may be placed in it. A very portable form of this instrument is then described, and also a refracting stereoscope suited for Daguerreotypes and small pictures not much exceeding the width between the eyes. In the latter instrument the pictures are placed side by side and viewed through two refracting prisms of small angle which displace the pictures laterally, that on the right side towards the left, and that on the left side towards the right, so that they appear to occupy the same place. When the first part of these investigations was published the photographic art was unknown, and the illustrations of the stereoscope were confined to outline and shaded perspective drawings; when, however, in the succeeding year, Talbot and Daguerre made their processes known, Mr. Wheatstone was enabled to obtain binocular Talbotypes and Daguerreotypes of statues, buildings, and even portraits of living persons, which, when presented in the stereoscope, no longer appeared as pictures, but as solid models of the objects from which they were taken. This application was first announced in 1841.

The two projections of an object, seen by the two eyes, are different according to the distance at which it is viewed; they become less dissimilar as that distance is greater, and, consequently, as the convergence of the optic axes becomes less. To a particular distance belongs a specific dissimilarity between the two pictures, and it is a point of interest to determine what would take place on viewing a pair of stereoscopic pictures with a different inclination of the optic axes than that for which they were intended. The result of this inquiry is, that if a pair of very dissimilar pictures is seen when the optic axes are nearly parallel, the distances between the near and remote points of the object appear exaggerated; and if, on the other

hand, a pair of pictures slightly dissimilar is seen when the optic axes converge very much, the appearance is that of a bas-relief. As no disagreeable or obviously incongruous effect is produced when two pictures, intended for a nearer convergence of the optic axes, are seen when the eyes are parallel or nearly so, we are able to avail ourselves of the means of augmenting the perceived magnitude of the binocular image mentioned at the commencement of this abstract. For this purpose the pictures, placed near the eyes, are caused to coincide when the optic axes are nearly parallel; and the diverging rays proceeding from the near pictures are rendered parallel by lenses of short focal distance placed before the mirrors or prisms of the stereoscope.

Some additional observations are next brought forward respecting those stereoscopic phenomena which the author, in his first memoir, called "conversions of relief." They may be produced in three different ways:—1st, by transposing the pictures from one eye to the other; 2ndly, by reflecting each picture separately, without transposition; and 3rdly, by inverting the pictures to each eye separately. The converse figure differs from the normal figure in this circumstance, that those points which appear most distant in the latter, are the nearest in the former, and *vice versa*.

An account is then given of the construction and effects of an instrument for producing the conversion of the relief of any solid object to which it is directed. As this instrument conveys to the mind false perceptions of all external objects, the author calls it a Pseudoscope. It consists of two reflecting prisms, placed in a frame, with adjustments, so that, when applied to the eyes, each eye may separately see the reflected image of the projection which usually falls on that eye. This is not the case when the reflexion of an object is seen in a mirror; for then, not only are the projections separately reflected, but they are also transposed from one eye to the other, and therefore the conversion of relief does not take place. The pseudoscope being directed to an object, and adjusted so that the object shall appear of its proper size and at its usual distance, the distances of all other objects are inverted; all nearer objects appear more distant, and all more distant objects nearer. The conversion of relief of an object consists in the transposition of the distances of the points which compose it. With the pseudoscope we have a glance, as it were, into another visible world, in which external objects and our internal perceptions have no longer their habitual relations with each other. Among the remarkable illusions it occasions, the following are mentioned. The inside of a tea-cup appears a solid convex body; the effect is more striking if there are painted figures within the cup. A china vase, ornamented with coloured flowers in relief, appears to be a vertical section of the interior of the vase, with painted hollow impressions of the flowers. A small terrestrial globe appears a concave hemisphere; when the globe is turned on its axis, the appearance and disappearance of different portions of the map on its concave surface has a very singular effect. A bust regarded in front becomes a deep hollow

mask; when regarded in profile, the appearance is equally striking. A framed picture, hung against a wall, appears as if imbedded in a cavity made in the wall. An object placed before the wall of a room appears behind the wall, and as if an aperture of the proper dimensions had been made to allow it to be seen; if the object be illuminated by a candle, its shadow appears as far before the object as it actually is behind it.

The communication concludes with a variety of details relating to the conditions on which these phenomena depend, and with a description of some other methods of producing the pseudoscopic appearances.

January 15, 1852.

COLONEL SABINE, V.P., and Treas., in the Chair.

A paper was read, entitled, "On the Development of the Ductless Glands of the Chick." By Henry Gray, Demonstrator of Anatomy at St. George's Hospital. Communicated by W. Bowman, Esq., F.R.S. Received November 12, 1851.

In this paper the author has demonstrated the evolution of the spleen, supra-renal and thyroid glands, and the tissues of which each is composed, in order to show the place that may be assigned to each in a classification of the glands.

The *spleen* is shown to arise between the 4th and 5th days, in a fold of membrane which connects the intestinal canal to the spine (the "intestinal lamina"), as a small whitish mass of blastema, perfectly distinct from both the stomach and pancreas. This fold serves to retain it and the pancreas in connection with the intestine. This separation of the spleen from the pancreas is more distinct at an early period of its evolution than later, as the increased growth of both organs causes them to approximate more closely, but not more intimately with one another; hence probably the statement of Arnold, that the spleen *arises* from the pancreas. With the increase in the growth of the organ and the surrounding parts, it gradually attains the position that it occupies in the full-grown bird, in more immediate proximity with the stomach; hence probably the statement of Bischoff, that it *arises* from the stomach. Later, when its vessels are formed, the membrane in which it was developed is almost completely absorbed.

The author then considers the development of the tissues of the spleen, which clearly establishes, not only the glandular nature of the organ itself, but the great similarity it bears with the supra-renal and thyroid glands.

The external capsule and the trabecular tissue of the spleen are both developed between the 8th and 9th days, the former in the form of a thin membrane composed of nucleated fibres, the latter consisting of similar fibres, which intersect the organ at first sparingly, and afterwards in greater quantity. The development of the blood-